



An Energy Efficiency Workshop & Exposition

Palm Springs, California

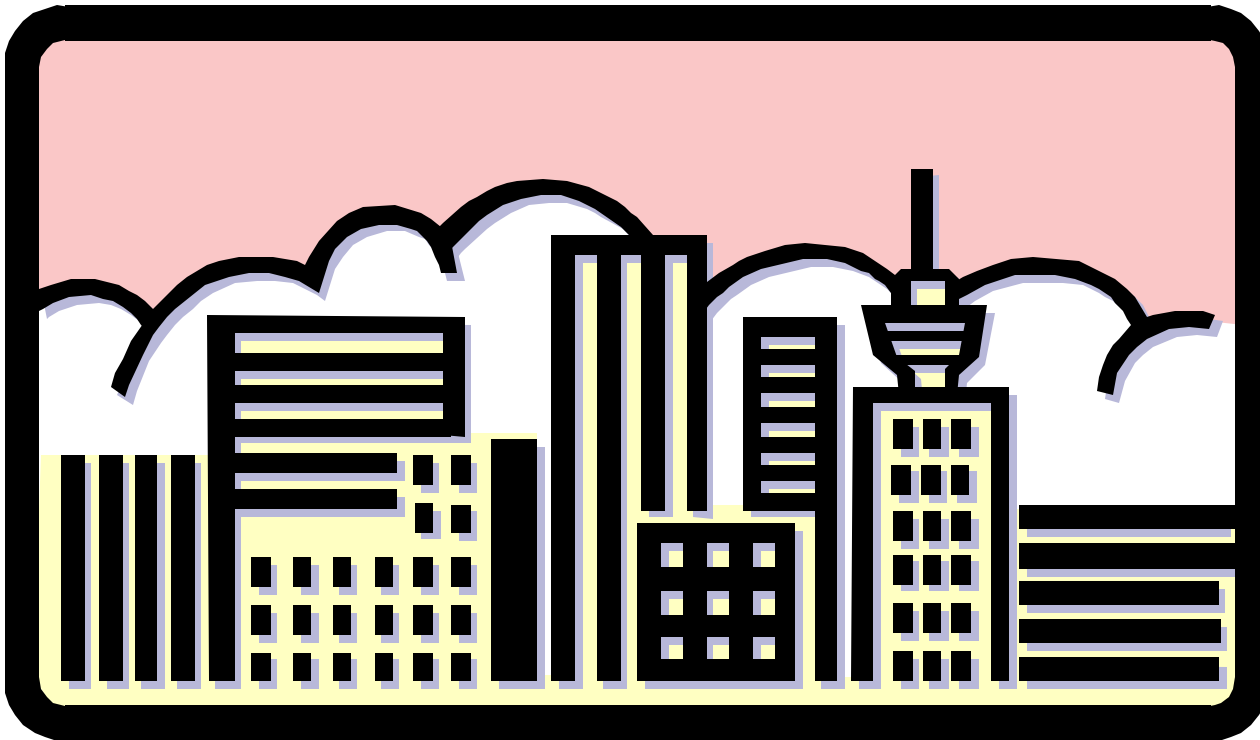
*IEQ and Health –
Current Research Findings and the
NORA IEQ Research Agenda*

Mark J. Mendell, Ph.D.

June 6, 2002 - 4:00-5:30 p.m.



Environmental Energy





- Introduction
- Current Knowledge -- Effects of IEQ
- Recommended IEQ Research
- Conclusions



INTRODUCTION



Indoor environments and health – why important?

- People in US spend over 90% of time indoors
- Indoor exposures different from outdoor, often higher
- Evidence associates IEs with various adverse health effects and economic impacts



National Occupational Research Agenda (NORA)

- ❑ Nationwide consensus process within U.S. occupational health community
- ❑ Indoor Work Environments selected as a priority topic for improving worker health
- ❑ NORA Indoor Environment Team defined current knowledge and research needs



CURRENT KNOWLEDGE – EFFECTS OF IEQ



Current knowledge – IEQ and Health Effects

- Well-understood building-related illnesses
 - Legionnaires Disease (+ Pontiac Fever)
 - Hypersensitivity pneumonitis
 - Humidifier fever
 - Asthma
 - Carbon monoxide poisoning
 - Fiberglass – skin and eye irritation



Current Knowledge – IEQ and Health Effects

- Less well-understood building-related health effects
 - building-influenced respiratory infections
 - building-related asthma and allergic disease
 - building-related symptoms
 (“sick building syndrome”)



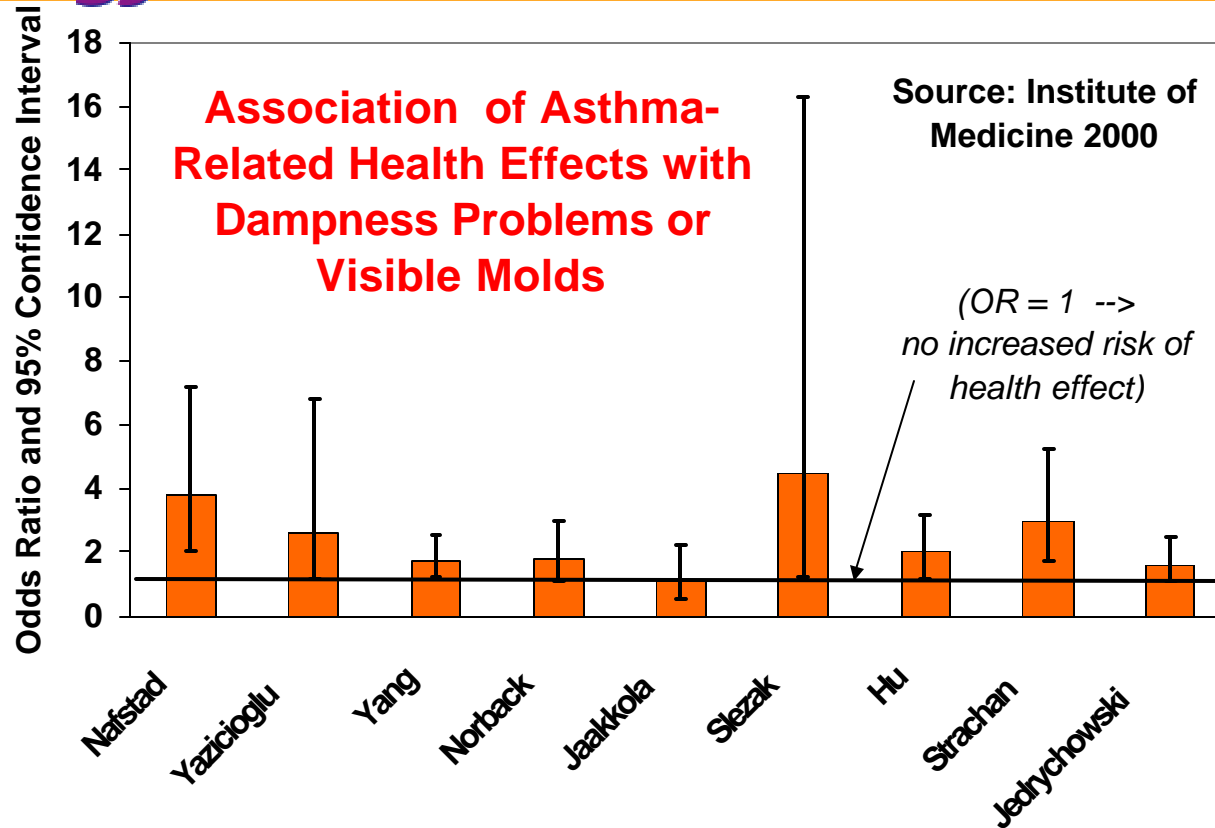
Current Knowledge -- Building-Influenced Respiratory Infections

- E.g., influenza, common cold, (TB)
- Evidence from multiple studies
- Suggests that building factors can substantially influence incidence of communicable respiratory infections among occupants



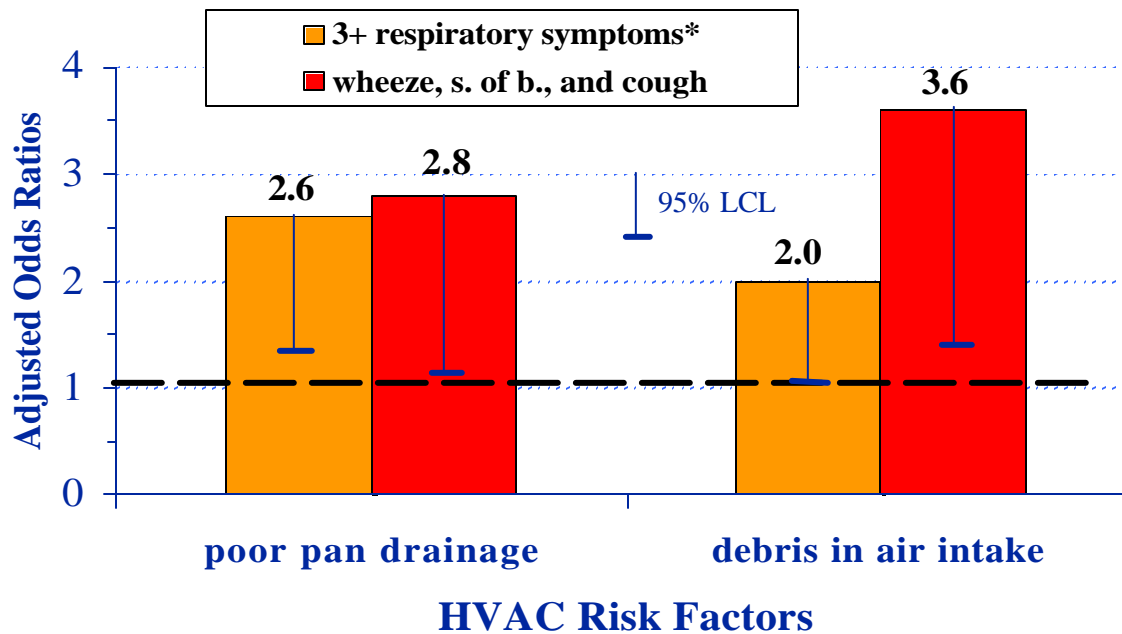
Current Knowledge -- Building-Related Asthma and Other Allergies

- Asthma
- Hypersensitivity Pneumonitis
- Allergic Rhinitis . . .





Adjusted Odds Ratios -- Risk Factors for Work-Related Respiratory Symptoms -- NIOSH Office Investigations***



* wheeze, shortness of breath, tight chest, cough

** Mendell and Naco, unpublished manuscript

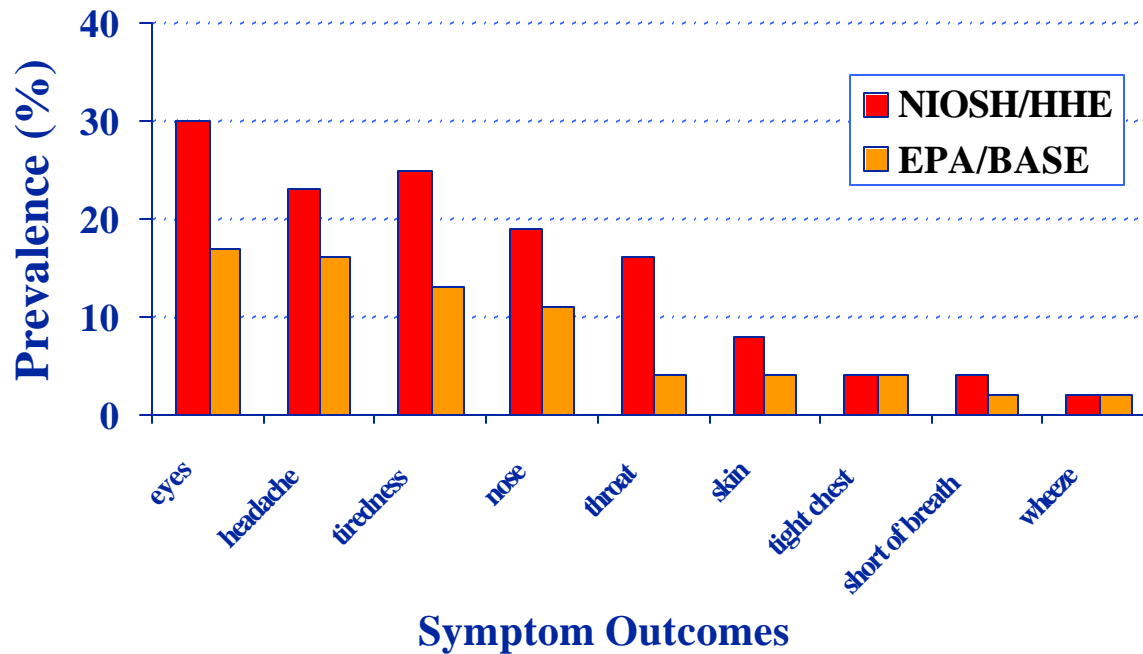


Current Knowledge -- Building Related Symptoms (BRS)

- e.g., irritated eyes, nose, throat, skin; headache, fatigue, breathing problems
- first known in “complaint buildings”
- also common in non-complaint buildings
- 23% of U.S. office workers have 2+ frequent, work-related symptoms
- evidence suggests BRS represents multiple human responses to multiple causes



Median Symptom Prevalences in NIOSH HHE and (29) EPA BASE Office Buildings





Examples of (Known or Suspected) Risk Factors for BRS

- low ventilation rate
- air-conditioned ventilation systems
- humidified ventilation systems
- moisture, dirt, related microorganisms
- high temperature
- volatile organic chemicals and pesticides
- personal factors (female, clerical, high job stress)



Current knowledge – BRS

- other building-related risks from some studies
 - carpet / fleecy materials
 - photocopier use
 - very low humidity
 - poor ventilation system design/maintenance
 - endotoxin (from bacteria)
 - (VOCs, plastic materials, formaldehyde)



Current knowledge – BRS and ventilation rate

- ventilation rates increasing up to 10 L/s-person
-- symptoms decrease significantly
- some studies indicate improvements even with much higher ventilation rates
- *no* apparent threshold or “no-further-benefit” level



Comparison of SBS Symptoms with Natural Ventilation and AC *Type of ventilation system*

First Author	Year	No of subjects	Natural Ventilation	AC + No Humid.	AC + Steam Humid.	AC + Evap. Humid.	AC + Spray Humid.
Jaakkola	95	868	○	●			
Mendell	96	710	○	●			
Mendell, Burge	90, 87	1459	○	●			
Mendell, Harrison	90, 87	1044	○	●			
Zweers	92	2806	○	●			
Jaakkola	95	335	○		●		
Mendell, Burge	90, 87	863	○		●		
Zweers	92	3573	○		●		
Jaakkola	95	559	○			●	
Teeuw	94	927	○			●	
Mendell, Burge	90, 87	1991	○			■	
Mendell, Finnegan	90, 87	787	○			■	
Mendell, Harrison	90, 87	2080	○			■	
Mendell, Hedge	90, 84	1214	○			■	
Zweers	92	3846	○				●
Brasche	99		○	■			
Hawkins	91	255	○	■			

○ = Reference Group

● = Significantly more symptoms

○ = Same #

Source: Seppanen and Fisk, in press



*Estimated Annual Health Effects Preventable by Improving Indoor Work Environments**

>65% of US workforce in indoor environments

- respiratory infections 6-8 M cases
\$3-5 B
- asthma and allergies 0.3-0.7 M asthma
1-3 M allergy
\$0.2-0.6
- B
- bldg-related symptoms 8-30 M
\$4-70
- B

* NORA Indoor Environment Team, AJPH 2002 in press



RECOMMENDED IEQ RESEARCH



NORA: Indoor Environment Priority Research Agenda

- Health effects – causes and prevention
 - building-influenced respiratory infections
 - building-related asthma and allergic disease
 - building-related symptoms
- Science and technology of indoor environments and buildings
- Improving implementation of knowledge on indoor environments and health



- Recommended building practices for IEQ and health
 - adequate outdoor air for health
 - proper ventilation system design, maintenance, and operation
 - ventilation system clean and dry
 - temperatures at lower end of comfort range
- Recommended research
 - key IEQ-related health effects
 - science and technology of indoor environments
 - improving implementation of IEQ knowledge in buildings



END